Effects of diagram format and user numeracy on understanding cash flow data

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Abstract

An issue of longstanding concern in accounting information systems is the effective presentation and communication of financial data to users with little accounting background. Cash flow statements in particular have been singled out as difficult to interpret. To increase user understanding of cash flow data, this study explores the potential merits of diagram formats, as well as possible effects of the user's numeracy skills. The study covers an experiment ($N = 100$) in which users were queried on their understanding of the cash flows of a real-world company, and in which type of format was either a cash flow statement or a cash flow diagram. Understanding was measured by three different concepts: interpretation accuracy, company diagnosis, and clarity of presentation. The study confirms that, on those measures, diagrams do not necessarily outperform cash flow statements, and that format familiarity (irrespective of the type of format) is a key driver in understanding cash flows. In addition, the study finds that numeric preference, but not numeric ability, helps in understanding cash flow data. The study discusses the sobering implications for designers of accounting information systems.

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Introduction

An issue of longstanding concern to designers of accounting information systems is the effective presentation and communication of financial data (Dull & Tegarden, 1999 and 2004; Moriarity, 1979). Users with little accounting background who are nonetheless expected to use financial reports often find it difficult to interpret financial data. This difficulty is met both within organizations, where non-financial managers must assess management accounting information, as well as outside organizations, where non-professional stakeholders read financial reports for personal investment purposes (FRC, 2012). Cash flow statements in particular have been singled out as being "the most unintelligible and un-useful document of the annual report" (quote from a finance director in CIMA, 2009, page 6).

To be sure, a better understanding of cash flow data can come about through appropriate accounting education, and it can be further enhanced by gaining experience in the industry sector in which the company operates. The importance of cash flow education and experience notwithstanding, many users do not have access to such education, and many lack the relevance experience. In these situations, it becomes of practical and theoretical interest to examine whether individual differences and the form of presentation of cash flow data are sufficiently appropriate to understand cash flow data.

The interest of this study is in exploring effects of such individual differences and presentation formats. Specifically, the study looks at the potential merits of *diagram formats* of cash flow data, as well as effects of the user's subjective *numeracy*. Variations in these key antecedents are explored to examine whether they improve the user's understanding of the cash flow data, especially in situations where the user has received very little specific accounting education or gained very little experience.

The use of diagrams is well-established in (software) engineering, and the benefits of diagrams for representing data are widely understood (Cheng, Lowe, & Scaife, 2001; Larkin & Simon, 1987; Olivier, 2001). In the accounting domain, however, the use of diagrams is much less common, and typically extends to business process diagrams for internal control purposes (Borthick, Schneider, & Vance, 2012). Such applications notwithstanding, the International Financial Reporting Standards (IFRS) and US Generally Accepted Accounting Principles (US GAAP) do not suggest the

use of diagrams. The first objective of this study is therefore to examine critically the merits of using diagrams to represent cash flow statements.

A further aspect explored in this paper is the effects of the user's numeracy on understanding cash flows. Numeracy skills are typically divided into numeric ability and numeric preference (Fagerlin et al, 2007, Ziklund-Fisher et al., 2007). Although a relationship between these two numeracy concepts and an understanding of cash flow data may *a priori* be assumed to exist, it is unclear which of these concepts would have the strongest relationship, and it is also unclear what the relationship would be if the level of familiarity with a specific cash flow format is taken into account. The second research question of the paper is to explore these aspects of user numeracy, in particular the magnitude of the effects of numeracy on cash flow understanding when controlling for format familiarity.

To address these research question, the study covers an experiment in which users were queried on their understanding of the cash flows of a real-world company, and in which type of format of cash flow data was varied across two groups. Before the format was displayed, respondents were being administered a subjective numeracy scale, which in other fields has been shown to have predictive ability for objective numeracy. Understanding was measured using three different concepts: interpretation accuracy, company diagnosis, and clarity of presentation. The study confirms that, on those measures, diagrams do not necessarily outperform cash flow statements, and that format familiarity (irrespective of the type of format) is a key driver in understanding cash flows. In addition, the study finds that numeric preference, but not numeric ability, helps in understanding cash flow data.

The structure of the remainder of this paper is as follows. The next section briefly outlines relevant theory, culminating in a set of hypotheses relating type of format and subjective numeracy to enhanced understanding of cash flow data. The paper then proceeds by explaining the procedures and instruments of the experiment, designed to test the hypotheses. The next section presents the statistical results of the experiment, and the final section discusses the findings and concludes.

Theory and hypotheses

A cash flow statement is one of the statements which companies must publish each year. It summarizes the inflows and outflows of cash for the year. Cash flow statements follow a format set out by accounting regulations. For example, under US

GAAP and IFRS,[1] flows are always grouped under three headings: operating, investing and financing.

Operating cash flows result from the principal activities of the firm that produce revenue. They include receipts of cash from customers, and payments of cash to suppliers or as wages. Investing cash flows result from investment activities: the acquisition and disposal of long-term assets such as land or buildings. Examples include payments to buy land and buildings, and receipts if land or buildings are sold. Financing cash flows result from activities that change equity (for example, issuing company shares) or borrowings (for example, getting a bank loan). Financial cash flows include cash paid out as dividends to shareholders. When these flows are added up, any net inflow (outflow) will explain the period's increase (decrease) in the amount of cash and cash equivalents[2] (hereafter, abbreviated to "cash").

Under US GAAP and IFRS, the flows are listed in tabular form. Totals and subtotals allow for varying degrees of aggregation. Table 1 shows the most elementary structure of the cash flow statement.

Table 1 Example of Summary Cash Flow Statement under US GAAP or IFRS

	20XX
1. Net cash from operating activities	300
2. Net cash used in investing activities	(150)
3. Net cash used in financing activities	(100)
4. Net increase in cash (1 + 2 + 3)	50
5. Cash at beginning of period:	400
6. Cash at end of period:	450

Understanding cash flow data

The study is concerned with the understanding of cash flow statements, and more particularly, with potential factors that would help to increase this understanding. To be sure, understanding is a somewhat vague "umbrella" concept, and for the purposes of this study it is operationalized into three parts: accuracy of interpretation, company diagnosis, and perceived clarity of presentation. Examining understanding on multiple

[1] In the case of IFRS, this is required by IAS 7, para. 10.

[2] Approximately speaking, this includes investments with up to three months remaining maturity at the date of purchase.

aspects avoids a risk of studying one aspect in isolation: the effects of varying presentation and numeracy may fail to register on that one aspect being studied, whilst effects on other aspects may go unnoticed.

The first component is accuracy of interpretation. The interest here is whether users can accurately reproduce key aspects of cash flow statements. For example, given the cash flow statement in Table 1, do the investing activities use or generate cash? Does the overall cash balance increase or decrease, and by how much? All else being equal, a superior presentation of cash flow data would have the highest accuracy of interpretation.

The second component is company diagnosis. The interest here is whether users are able to form an overall evaluation of the performance of the company on the basis of the cash flow data. For example, does the cash flow profile of this company give cause for concern? Is it likely to survive? All else being equal, a superior presentation of cash flow data would allow users to form better judgements of the financial health of the company.

The third and final component is clarity of presentation. The interest here is in the subjective opinion of how clear and understandable the presentation is to the user. For example, do the users agree (or disagree) that the cash flow statement in Table 1 is informative? Do they agree that it is clear? All else being equal, a superior presentation of cash flow data would register higher scores on such perceptual questions.

Cash flow data can be presented in a variety of forms. They can be prepared using either the direct or the indirect[3] method, a distinction that reflects how operating cash flows are calculated.[4,5] Most accounting information systems, including the leading enterprise systems, are able to produce statements using both methods.

Although there is variation in direct and indirect presentation of operating cash flows, most if not all presentations of cash flow data are in the form of tabular statements, similar to the one in Table 1. This study examines the potentially beneficial effect of a cash flow *diagram*. Diagrams expose the underlying *system* that gives rise to the data. Adopting terminology from systems engineering (for example, data flow diagrams,

[3] The indirect method calculates operating cash flow by starting with profit and adjusting for non-cash items.

[4] Under IFRS, this is dealt with in IAS 7, para. 18.

[5] Klammer and Read (1990) show that bank analysts vary less in the size of loans which they grant when using the direct (rather than the indirect) method of calculating operating cash flows.

DeMarco, 1979) [6], systems contain *elements* which exchange flows of data, information, people, and cash. [7]

In the context of a cash flow statement, the firm engages in operating, investing, and financing activities. There are three corresponding elements in the "firm system". These are abstract: they do not, as a rule, correspond with real organizational units within the firm. There are two more elements in the cash flow statement system: one responsible for holding the cash balance, and one that represents the "hatch" through which the other four elements exchange cash flows. A diagram can be constructed that connects these elements through directional arrows, each representing a cash flow. If an arrow points from an activity towards the diamond, this means that the activity *generates* cash (provides a cash inflow) in the particular firm in that period. By contrast, if an arrow points from the diamond element towards the activity, this means that the activity *absorbs* cash (requires a cash outflow). Figure 1 depicts a diagram of these elements and cash flows, using the data of Table 1.

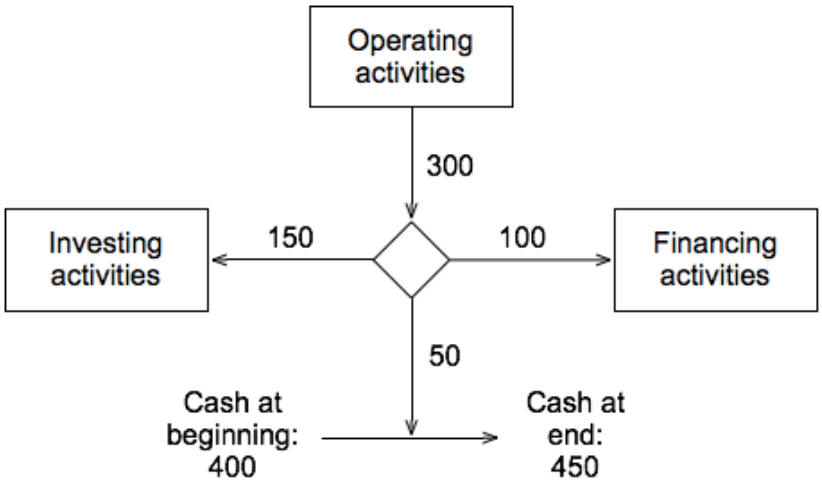

Figure 1 A diagram of elements and cash flows

The first hypothesis is grounded in a theoretical perspective on cognition that is known as the information processing model (Simon, 1979). This perspective focuses on thought processes for effective problem solving, and breaks them down into elementary information processing tasks (EIPs). Many EIPs involve the manipulation

[6] In practice, diagrams from the Unified Modelling Language (UML) and Business Process Modelling Notation (BPMN) have superseded data flow diagrams. These new diagrams contain ideas originally put forward in data flow diagrams.

[7] In this context, the system is meant to indicate the firm itself: it is not to be confused with an information system that records and presents the financial data.

symbolic “chunks” of information that are logically indexed and connected to arrive at a solution (Simon, 1974). The hypotheses here concerning the effectiveness of cash flow diagrams originate in the notion that a diagram facilitates such manipulation more than a cash flow statement does.

Diagrams are not necessarily more helpful than other representations (Cheng et al., 2001). They are, however, known to be more useful than tables when they offer “perceptual enhancement” (Larkin & Simon, 1987). This enhancement may come about in two ways. First, a diagram can make the underlying logical expressions to evaluate data more explicit. Such expressions are only implicit in tables, and it may require cognitive effort on the part of the user to retrieve them. The diagram more explicitly presents the activities as distinct groups within a system, in a way that a tabular listing does not. Secondly, a diagram aims to represent the logical steps to solve a problem in a spatial way to enhance perceptual understanding even further. Diagnosis takes place by smooth traversal of the diagram, requiring little cognitive effort (Larkin & Simon, 1987). The diamond element in conjunction with the inflows and outflows aims to provide a clearer picture of how the cash flows were distributed among the four remaining elements. Such an distribution is only implicit in the cash flow statement. Based on these features for perceptual enhancement, the expectation is that the cash flow diagram will enhance understanding.

Hypothesis 1

Users of a cash flow diagram will demonstrate greater understanding of the cash flow data than users of a cash flow statement.

Another key factor in understanding cash flow statements may be a person’s ability to understand, or have a preference for, numbers. Ability and preference are frequently combined and presented as numeracy skills (Zikmund-Fisher et al., 2007). To be sure, one can conceptualize the understanding of cash flows as a skill in and of itself, as part of a degree of financial literacy. A disposition towards such financial literacy may well be preceded by numeric ability and numerical preference, because an understanding of financial data does require the manipulation of numbers. This leads to the second and third hypothesis of this paper.

Hypothesis 2

Users who report greater levels of numeric ability will demonstrate greater understanding of the cash flow data than users who report lower levels of ability.

Hypothesis 3

Users who report greater levels of numeric preference will demonstrate greater understanding of the cash flow data than users who report lower levels of preference.

A final factor of interest is the user's familiarity with the format in which the cash flow data is presented. It may seem somewhat obvious (and perhaps trivial) to hypothesize that does who are more familiar with cash flow formats will understand it better. The reason, nonetheless, to include this hypothesis is because it controls for the *novelty* effect that a new format such as a diagram may bring about. A novelty effect arises when positive or negative effects occur simply because one stimulus is new and the other is not. In situations where one format is very well established (the cash flow statement) and the other format is brand new (the cash flow diagram), such a novelty effect is a realistic threat. This leads to the final hypothesis of the study.

Hypothesis 4

Users who are familiar with the cash flow presentation format will demonstrate greater understanding of the cash flow data than users who are less familiar.

Method

In order to test the hypotheses, a 1 x 2 between-subject experiment was designed. In the experiment, two groups receive the same cash flow data about a firm: one group has access to its cash flow statement and the other group has access to a cash flow diagram. Respondents were queried regarding interpretation accuracy, evaluation of the firm, and clarity of presentation. A number of potential control variables were incorporated in the experiment, including age, gender, employment status, student status, and work experience.

The experiment used cash flow data of LVMH, a French luxury goods company, for the year 2012. This cash flow profile is considered to be 'normal' for a mature company: inflows arise from operating activities and outflows end up in investment and financing activities, where the majority of the latter is the payment of dividends.

The cash flow statements and the cash flow diagrams based on this firm are shown in the appendix. Diagram and statement were designed to be informationally equivalent (Larkin & Simon, 1987): a user must be able to transfer one presentation into the other without loss of information, or else the superiority of a particular representation could be attributed to increased informational content instead of the format.

Procedure

The experiment took place entirely online, with respondents recruited through an online research panel. Such respondents have a varying degree of accounting sophistication, and are typically unaware of the precise details that surround cash flow statements. Choosing these respondents therefore helps to ensure that both the statement and the diagram are perceived to be equally "new." A tutorial on cash flow data was provided to participants before they start the experiment. This tutorial covered the division of cash flow data in three groups, but did not present cash flow data in either format. The tutorial contained several tutorial questions, the correct answers to which users had to provide before they could proceed with the experiment. Care was taken to ensure that the tutorial did not lead the respondent to favour a specific format.

Figure 2 illustrates the steps that respondents perform as they take part in each of the three experiments.

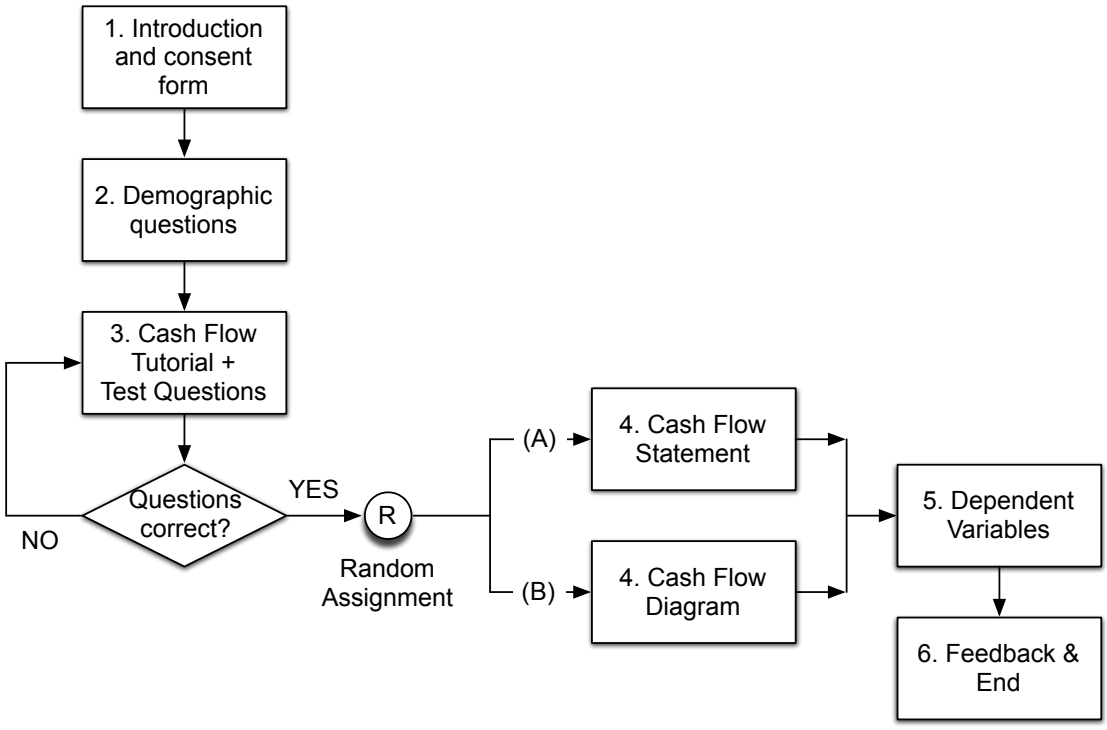

Figure 1 An overview of steps that respondents take in the experiment

Participants first arrive from the online research panel to a landing page, which welcomes them to the experiment, explains the nature of the experiment, and asks for consent (Step 1). Following this, the respondent is asked demographic questions, and is administered the subjective math skills scale (Step 2). The tutorial is then provided. As discussed, respondents were not able to continue with the experiment if they did not answer the tutorial questions correctly (Step 3). A random assignment then takes place such that the respondent is either administered the cash flow statement or the cash flow diagram (Step 4). The scales for the dependent variables (discussed below) are then administered. Finally, the experiment offered an opportunity for feedback and a closing thank you page.

Measures

Following exposure to the two cash flow presentation formats, respondents were asked three questions to verify accuracy of interpretation. The first question asked how much the operating activities of the company used or generated. The second question asked how much the investing activities used or generated. The final question asked by how much the overall cash balance increased or decreased. The number of correct answers formed the accuracy measure of the study. This dependent variable ranged from 0 to 3. Please note these were not test questions like those that followed the tutorial: respondents could proceed with the experiment even if they had answered incorrectly. There was no feedback to the respondents regarding accuracy of the answers.

The second dependent variable related to the evaluation of the company. Respondents were asked to rate the company on four seven-point semantic differentials: likely to survive, no cause for concern, effective management, and low investment risk. The higher the score, the more positive respondents were about the company. Scores were summated to form the second variable of the study, ranging from 4 to 28. This subjective measurement of company health was adapted and extended from a measure previously used by Maines & McDaniel (2000)[8].

The third dependent variable related to clarity of presentation. Seven-point Likert scales are used to capture this concept similar to other studies that adopt an experimental approach to presentation formats (e.g., van der Heijden, 2013). Users were asked to rate the way in which the cash flow was presented in terms of clarity,

[8] Maines & McDaniel (2000) used a 14-point scale to measure management effectiveness and investment risk.

understandability, informativeness, and usefulness. These scores too were summated, and this resulted in the third and final dependent variable of the study (ranging from 4 to 28).

To measure numeracy, the study used a validated scale on subjective numeracy developed by Fagerlin et al. in the context of medical decision making (Fagerlin et al., 2007). This scale contains four questions relating to numeric ability and four questions relating to numeric preference.

Finally, to measure familiarity with the format, respondents were simply asked to rate their familiarity with the format on a seven-point Likert scale ranging from Very Unfamiliar to Very Familiar.

Sample

Table 2 presents a summary of the demographic characteristics of the sample. To verify that the software had successfully carried out random assignment of respondents to format condition, chi-squared tests were conducted. These tests (not reported here) confirmed that no demographic characteristic (gender, age, education, employment status, student status, or working experience) was under- or overrepresented in either format condition.

Results

The results section is structured as follows. The section begins with an analysis of the psychometric properties of the subjective numeracy scale. The section then proceeds with an analysis of key dependent and independent variables for each of the two groups in the experiment. Finally, two regressions are provided to test the four hypotheses directly.

Table 2 Demographic characteristics of sample (N = 100)

Characteristic	n
Gender	
Male	59
Female	41
Age	
Younger than 21	1
21-30	52
31-40	29
41-50	11
51-60	6
61-70	1
Older than 70	0
Education	
High school	11
Some college	30
Associate (or college) degree	14
Bachelor's degree	38
Master's degree	6
Doctoral degree	1
Employment status	
Working full-time	52
Working part-time	13
Self-employed	19
Casual employment	3
Other form of paid employment	3
Not currently in paid employment	9
Prefer not to say	1
Student status	
Studying full-time	10
Studying part-time	7
Not currently undertaking formal study	82
Prefer not to say	1
Working experience	
No working experience	0
1-2 years	12
3-5 years	21
6-10 years	29
11 years or more	37
Prefer not to say	1

The subjective numeracy scale is not yet widely used in behavioural accounting research, and it is therefore of interest to report the psychometric properties of this scale in some detail. After reverse scoring the responses to the 7th question on the scale, a principal component analysis with varimax rotation was conducted on the entire scale. This analysis seeks to establish its underlying dimensional structure, and confirm that it measures numeric ability and preference seperately. The measurement items, descriptive statistics, and factor loadings are reported in Table 3.

Table 3 Principal component analysis with varimax rotation of Subjective Numeracy Scale (N = 100). All items are measured on 1 to 6 scale. Item 7 (*) is reverse scored. Factor loadings lower than .5 not shown.

	M	SD	Factor 1 loadings	Factor 2 loadings
1. How good are you at working with fractions?	3.85	1.41	0.77	--
2. How good are you at working with percentages?	4.20	1.30	0.75	--
3. How good are you at calculating a 15% tip?	4.72	1.31	0.90	--
4. How good are you at figuring out how much a shirt will cost if it is 25% off?	4.86	1.18	0.90	--
5. When reading the newspaper, how helpful do you find tables and graphs that are parts of a story?	4.49	1.24	0.50	0.53
6. When people tell you the chance of something happening, do you prefer that they use words ("it rarely happens") or numbers ("there's a 1% chance")?	4.36	1.58	--	0.80
7. When you hear a weather forecast, do you prefer predictions using percentages (e.g., “there will be a 20% chance of rain today”) or predictions using only words (e.g., “there is a small chance of rain today”)? *	4.52	1.58	--	0.84
8. How often do you find numerical information to be useful?	4.85	1.05	--	0.70
Cronbach’s Alpha			0.90	0.78

The analysis demonstrates that the subjective numeracy scale measures, as expected, two different concepts: the first four items measuring (subjective) numerical ability and the last four items measuring numerical preference. Psychometric tests were

satisfactory, with the KMO score of sampling adequacy being 0.81 and Bartlett's test of sphericity statistically significant. The internal consistency of the two sub-scales, as measured by Cronbach's alpha, was also acceptable (see Table 3). As a consequence of this analysis, the sub-scales of ability and preference will be used. A score was created for numerical ability by summing scores for items 1-4, and one for numerical preference by summing scores for item 5-8 (with 7 reverse scored).

Table 4 shows the dependent variables and independent variables for each of the two groups, statement and diagram.

Table 4 Descriptive statistics of key variables in the study across two format conditions (N = 100)

	Cash Flow Statement (n = 51)		**Cash Flow Diagram (n = 49)**			
	M	*SD*	*M*	*SD*	*t(98)*	*sig*
Dependent variables						
Interpretation accuracy (range 0..3)	2.73	0.60	2.29	0.81	3.07	.003
Clarity of format (range 4..28)	23.35	3.66	19.28	6.04	4.08	.000
Company diagnosis (range 4..28)	15.25	5.33	15.06	4.83	0.19	.850
Independent variables						
Numerical ability (range 4..28)	17.49	4.83	17.77	4.35	-0.31	.757
Numerical preference (range 4..28)	17.50	4.57	18.95	3.99	-1.68	.095
Familiarity with format (range 1..7)	4.04	1.35	2.51	1.43	5.48	.000

Note: Test is independent sample test for group means.

Recall that, following exposure to the two cash flow presentation formats, respondents were asked three questions to verify accuracy of interpretation. The number of correct answers formed the accuracy measure of the study. Table 4 shows that those in the statement condition had higher interpretations of accuracy (more questions correct on average) than those in the diagram condition. In addition, they found it clearer and more understandable, differences that are statistically significant. These results indicate, quite simply, that statements outperform diagrams on these two aspects of understanding. The hypothesis that diagrams would outperform statements is not supported.

As can be seen from Table 4, the type of format did not affect the diagnostic ratings of the company by respondents. The ratings were also not significantly associated with numerical ability, numerical preference and familiarity with format (correlation

coefficients were 0.06, 0.11, and 0.03 respectively). Therefore, further analyses on this aspect of cash flow understanding are not reported here.

To establish the relative importance of type of format, numeracy, and familiarity with format on the remaining two dependent variables, two multiple regressions were carried out. The following two equations were estimated:

1. Interpretation Accuracy = B_0 + B_1(Numerical Ability) + B_2(Numerical Preference) + B_3(Familiarity with format) + B_4(Format Dummy)
2. Clarity of Format = B_0 + B_1(Numerical Ability) + B_2(Numerical Preference) + B_3(Familiarity with format) + B_4(Format Dummy)

The format dummy was coded as 0 if the respondent was exposed to a cash flow statement and 1 if the respondent was exposed to a cash flow diagram. The results of the regressions are reported in Table 5.

Table 5 Summary of regression results predicting interpretation accuracy and clarity of format (N = 100)

	B	***Beta***	***t***	***Sig***
DV: Interpretation Acc. (R^2 = 0.19, p < .001)				
Constant	2.08			
Numerical Ability	0.00	0.01	0.16	.869
Numerical Preference	0.05	0.33	2.83	.000
Familiarity with Format	-0.10	-0.21	-1.87	.064
Format Dummy (0 = Statement, 1 = Diagram)	-0.67	-0.45	-4.11	.000
DV: Clarity of Format (R^2 = 0.33, p < .001)				
Constant	13.00			
Numerical Ability	0.02	0.01	0.18	.858
Numerical Preference	0.35	0.28	2.72	.008
Familiarity with Format	0.93	0.27	2.65	.009
Format Dummy (0 = Statement, 1 = Diagram)	-3.16	-0.29	-2.95	.004

These results indicate that, in terms of accuracy of interpretation, the type of format is a manipulation that produces significant effects. Consistent with the data from Table 3 the regression indicates that changing to a diagrammatic representation negatively influences accuracy. Accuracy is further influenced by numeric preference, but not by numerical ability, and not by familiarity of presentation.

In terms of clarity of presentation, the results are broadly consistent. Changing to a diagrammatic representation reduces clarity, and significantly so. This time, familiarity also plays a significant role, with the more familiar presentation creating

the greatest clarity. This is evidence of a novelty effect. Numerical preference agains plays a role, but numerical ability does not. Taking these results together, this indicates that hypothesis two is not supported (numerical ability does not influence understanding), but hypothesis three is (numerical preference does influence understanding). Hypothesis four (familiarity increases understanding) is also supported.

Discussion and conclusion

In this paper, the focus is on the role and importance of two key factors that may influence a user's understanding of cash flow data: the type of format in which the data was presented, and the user's numeracy (both ability and preference). Understanding was operationalized into three different components: accuracy of interpretation, diagnostics of the company, and clarity of presentation format. The key findings of the study are summarized in Table 6.

Table 6 Summary of findings

	Accuracy of Interpretation	**Company Diagnosis**	**Clarity of Presentation**
H1. Type of Format (Statement or Diagram)	Statement over Diagram	Either	Statement over Diagram
H2. Numerical Ability	No effect	No effect	No effect
H3. Numerical Preference	Positive	No effect	Positive
H4. Familiarity with format	No effect	No effect	Positive

It is worth reflecting on the negative effects that a diagrammatic representation of cash flow statement produced. This result does not appear to be consistent with the empirical literature on the interpretation of diagrams, which by and large finds positive effects. One reason, already alluded to and confirmed in the study, is the novelty effect: users were much less familiar with diagrammatic formats than they were with tabular formats. In addition, it could be that the design choices made to construct the diagram were underdeveloped. There was certainly evidence of confusion as to whether the directional arrows represented outflows or inflows. Perhaps more clarification in the diagram itself would have helped. Or perhaps a clear diagram required different design choices. It could also be that users were not very well attuned to interpreting diagrams, and perhaps a small tutorial would have helped. The need for such a tutorial, however, would negate the benefit of the diagrammatic format, since the tabular format would not have required such a tutorial.

Perhaps the most interesting finding of the study is that numerical preference but not numerical ability helps understanding of the cash flow data, irrespective of type of format. It could be that the numerical requirements to understand cash flow data, i.e., adding and subtracting numbers, are low, and sufficient for even the least able users. To test this explanation, a cash flow statement that is more complex could be designed, and if the explanation holds, then the more complex statement should only be accessible to the more numerically able respondents. This notwithstanding, the findings do suggest that it is not ability but willingness, or disposition to engage with numbers, that aids in understanding.

The study did not find any differences in company evaluation. Perhaps this is to be expected, and even reassuring, in the sense that formats by themselves ought not to materially alter user opinion. Having said that, one alleged advantage of diagrams is that it is easier to diagnose problems, because the steps to perform the diagnosis are made explicit (Cheng et al., 2001). Perhaps further research can exploit this advantage, for example by using cash flow data of a new firm that is in financial trouble. For example, unless a firm generally has net cash inflows from operations, it is unsustainable. In the long run, this net cash inflow is the only way of providing the firm's financiers with a return on their investment.[9] Thus, with the exception of a start-up phase, a going-concern firm is not expected to have negative operating cash flow. A diagram could perhaps be designed that highlights this problem if it exists. A follow-up experiment could then validate whether the users find it easier to spot the problem with the diagram rather than with the more established cash flow statement.

From a theoretical point of view, the research contributes to the body of knowledge that deals with the most effective ways of presenting financial data. This literature has (with some exceptions) looked primarily at the differences between numerical and graphical presentations of data, such as tables versus charts (Benbasat & Dexter, 1985; Benbasat & Dexter, 1986; Vessey, 1991). A contribution of this study is that it looks at differences between numerical and diagrammatic presentations. In the light of these differences, the findings are sobering: diagrammatic presentations underperform in comparison to tabular presentations, and on this basis a diagrammatic format cannot be recommended for future use. The study also

[9] This is the case for equity holders. It is also the case for loan finance, assuming that interest paid is treated as an operating cash outflow, which is required under US GAAP and is an optional treatment under IFRS (IAS 7, para.31).

highlights the usefulness of the subjective numeracy scale in an accounting information systems context, and draws attention to the predictive ability of at least one of the subscales, numerical preference. Perhaps further research can adjust the scale to an accounting context further.

The study opens up new questions for further research. Attention was drawn to the interpretation challenges faced by users with little accounting background, and the study looked at the role of numeracy and presentation format for this particular group. It remains to be seen whether the numeric preference and type of format are equally important for users who have developed an accounting background, either through education or through experience. Perhaps the assumption holds that education and experience would mitigate, even neutralize these effects, but as yet this assumption awaits empirically test. It would increase the generalizability of the findings to examine user groups with more developed accounting backgrounds.

The findings of this study are of interest to a number of groups. Designers of accounting information systems and preparers of financial statements may wish to reflect on the findings, in particular relating to the relative (un)usefulness of the diagrammatic format. The findings may also be of interest to accounting standard setters, who specify the requirements for cash flow statements. Ultimately, this may lead to the presentation of more useful cash flow statements, and a better understanding of the financial situation of firms by internal or external users of financial information.

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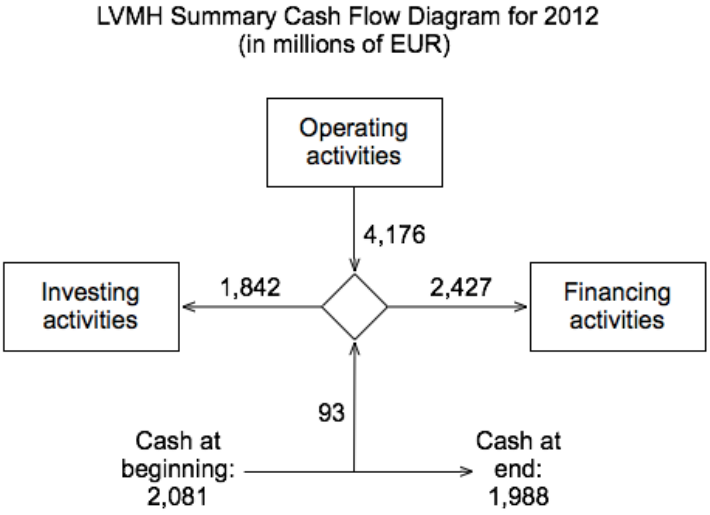
Appendix: Experimental materials

The study uses the cash flow data of LVMH, a French luxury goods company, for the year 2012. The table presents a summary of the cash flow statement, and the figure presents the corresponding cash flow diagram [10], [11].

LVMH Summary Cash Flow Statement for 2012
(in millions of EUR)

Net cash from operating activities:	4,176
Net cash used in investing activities:	-1,842
Net cash used in financing activities:	-2,427
Net decrease in cash:	-93
Cash at beginning:	2,081
Cash at end:	1,988



Cash Flow Diagram of LVMH for 2012 (in million EUR)

[10] LVMH distinguish between operational and financial investments. These investments are grouped here into one category.
[11] LVMH split this into equity and debt flows.